Implementation of Industry Technology into the Construction Management Department

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With technology being one of the fastest growing items in the construction industry it is important to keep on top of what is utilized most commonly. To fully prepare graduates for the work force, the Construction Management Department at Cal Poly, San Luis Obispo needs to focus efforts on supplying students with the most commonly used industry technologies. Utilizing these programs in the current curriculum will ensure that graduates from the Construction Management Department are prepared to take on the work force with the most relevant software under their belts. Students who understand how to use these industry sanctioned technologies will achieve greater success in the future due to the valuable and practical education these industry wide technologies provide.

Key Words: Technology, Software, Curriculum, Estimating, Scheduling, Industry

Introduction and Background

Over the past four years, Forster has been exposed to a variety of software within the Construction Management Department, specifically ones that have been known to be used industry wide. The software programs utilized throughout the Construction Management Department are to help students understand the culture of the industry while teaching best practices that students will be showcasing in a professional setting once they graduate.

By winter quarter of her senior year, Forster was enrolled in the major required course CM 443, otherwise known as Management of the Firm to the Construction Management student body. This class was Forster's first time being exposed to the how a construction company is managed and the different software's used in all aspects of the construction process. While Forster sat in lecture and learned about the different types of construction software applications which include the following:

- Bid Management
- Estimating/ Take Off
- Project Schedule
- Accounting/ Job Cost
- Document Management
- Project Management
- BIM
- Project Monitoring

she began to realize the Construction Management Department focuses on a miniscule amount of these applications while only teaching students what they believe are most commonly used in industry. With such a large quantity of software available throughout industry, in addition to Cal Poly Construction Management graduates being recruiter's top choice, students should be exposed to more than one of each type of the software's listed above. Once graduated and working in industry, students should feel more the confident in the technological skills gained during their time at Cal Poly San Luis Obispo.

Project Goals

The primary goal for this project involves looking towards industry members to expand on what technology skills they would like to see from recent graduates of Cal Poly's construction management department. Forster wants to provide students the opportunity to learn the programs that are utilized throughout the construction industry while also allowing students to feel confident that these programs are not just resume fillers, but actual software programs that will be used in industry, aligning with Cal Poly's "Learn By Doing" motto.

Methodology

The first step in researching Forster's subject was to educate herself by completing a literature review. It was important for Forster to learn about construction software covered in other articles and dissertations. This literature review gave her a solid understanding about the current uses of construction software in the industry as well as where Cal Poly Construction Management program stands in relation to other schools and industry professionals. Education is the basis which students rely on while being prepared to dive into industry practices. In a study conducted at North Carolina Central University, the authors concluded that it is important that young employees are adequately prepared in both current and future technology proficiencies (Grant, et al., 2009). In order to become well versed in current and future software's, students must be given the opportunity to learn different forms of programs. With new technologies emerging at an ever-increasing rate, it is intuitively important for schools to keep up on both new hardware and software, which in turn allow for their graduates to become more successful (Engelhardt, Suermann, 2014).

The next step in Forster's research was to look towards industry members to see what they software applications they most commonly used and what they expect their new hire graduates to have a basic understanding of prior to beginning work. After reaching out to Cal Poly's Construction Tech Advisory Board, a branch under control of the Construction Management Advisory Council (CMAC), VDC Engineer Matty Reed responded. Reeds response included CTAC's 22 question survey which was sent to CMAC's industry network gathering data about technology utilized in the AEC Industry. Reeds survey collected 39 responses which were mostly from General Contractors. Having results from general contractors was able to help focus Forster's research because most students in the department are planning to work for general contractors in the future.

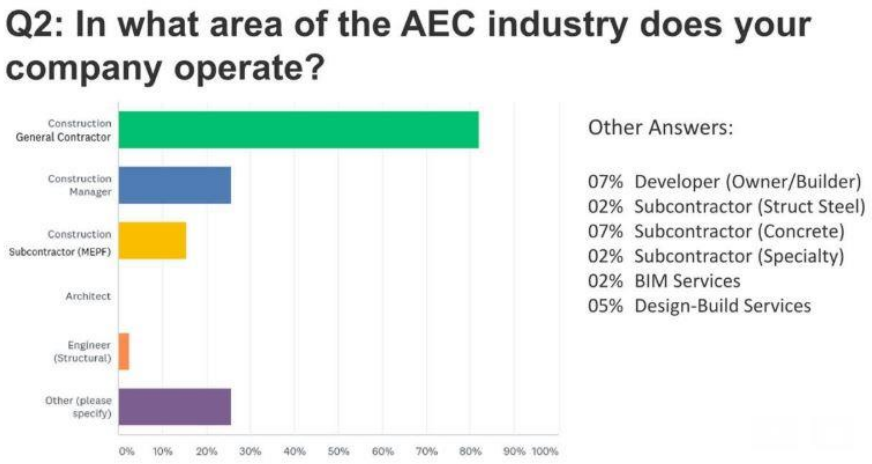

Figure 1: Industry Participation

The final step in Forster's research included qualitative data. The data was collected through Survey Monkey® and sent out through the Construction Management current student list which includes freshman through seniors in the Construction Management Department. After analyzing the results of CTAC's

industry wide survey of Technology Utilization in the AEC Industry, questions for Forster's survey were based around the results of what software was used most commonly throughout the industry. Results were collected for 1 week beginning May 14, 2018 and ending May 22, 2018. The survey consisted of 10 questions regarding information in the following categories:

- School year of each student completing the survey
- Comfortability using Microsoft Office applications
- Comfortability using Bluebeam as a document control application
- Comfortability using Procore as a project management application
- Comfortability using P6 as a scheduling tool
- Comfortability using Microsoft Project as a scheduling tool
- Comfortability using Bluebeam as a quantity takeoff tool
- Comfortability using AutoCAD as modeling software
- Comfortability using Revit as modeling software
- Importance of different software's.

Results

Respondents from the student survey are shown in the chart below (see figure 2). The following information was gathered through an online survey directed at the entire student body of the Construction Management Department. The breakdown of student year in school are as followed: 3.7% of students who completed the survey were 1st year students, 14.81% of students who completed the survey were 2nd year students, 31.48% of students who completed the survey were 3rd year students, 42.59% of students who completed the survey were 4th year students, and 7.51% of students who completed the survey were 5th year students in the Construction Management Department.

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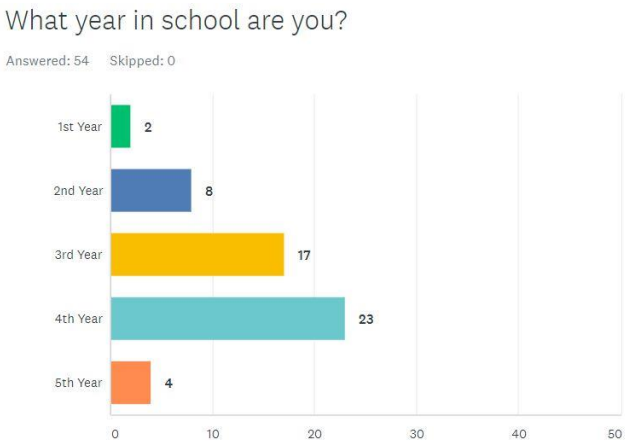


Figure 2: Year in School - Student Body

Below is a breakdown by application comfortability from the student body compared to the results from the industry survey.

Document and Spreadsheet Applications

The first activity analyzed were applications used to create documents and spreadsheets. This activity is important in all sectors of construction. Understanding how to properly make a spreadsheet in Excel, knowing how to format a power-point presentation, and utilizing Word documents are activities used daily in the construction industry. Below is a side by side comparison for industry use of Microsoft Office programs to student comfortability using Microsoft Office programs. As indicated by the charts (see figure 3 and figure 4), 100% industry use of Microsoft Office aligns well with the average 84% comfortability rating from the student body. This close alignment ensures employers that new hires will be able to properly use Microsoft Applications once they begin work.

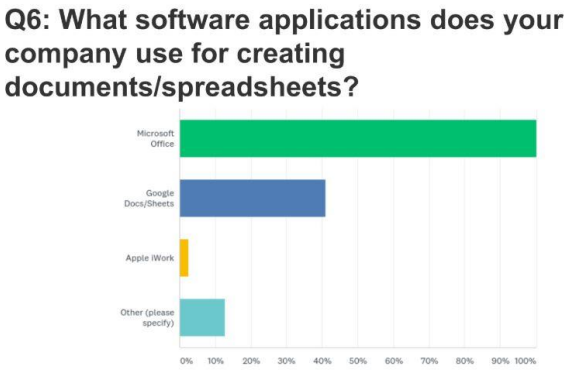


Figure 3: Industry Use of Document/Spreadsheet Applications

Document Control

The next construction software analyzed were applications used for document control. This activity is one of the most common in the construction industry, so it is imperative that new hires understand how to properly use applications that deal with document control. These applications include, but are not limited to, viewing, manipulating, and organizing PDF's. As seen below (see figure 5), the front runner with industry members is Bluebeam with a 100% usage. This aligns well with the CM Department because Bluebeam is used throughout all labs as a document control tool and an estimating tool. However, with average student comfortability at 80%, the department should look into ways to better teach Bluebeam so students do not fall behind on their internships and first jobs due to the learning curve Bluebeam comes with.

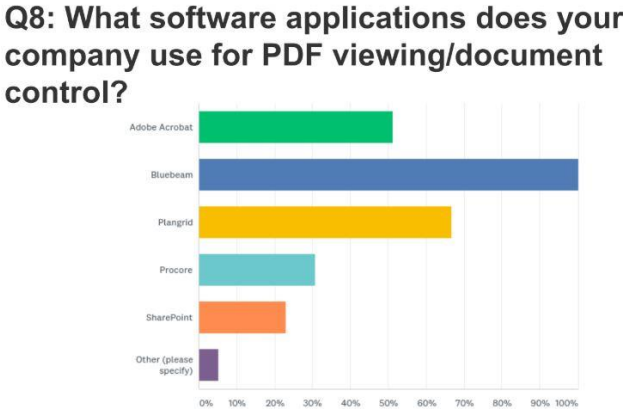


Figure 4: Industry Use of Document Control Applications

Project Management Applications

The next item analyzed in Forster's research was project management applications. Project management applications include the ability to complete RFI's, submittals, change orders, timesheets, daily logs, and other activities. Due to the results of the industry survey, Procore was chosen over CMiC, Timberline, and Prolog which were all close competitors. With student comfort of Procore at an average of 49%, the department should incorporate Procore into more labs. Students are exposed to Procore in CM 413, however, being introduced to the properties of project management applications earlier in the curriculum would benefit students greatly. This implementation would allow students to jump ahead of other construction management departments while giving students skills they are able to take to internships.

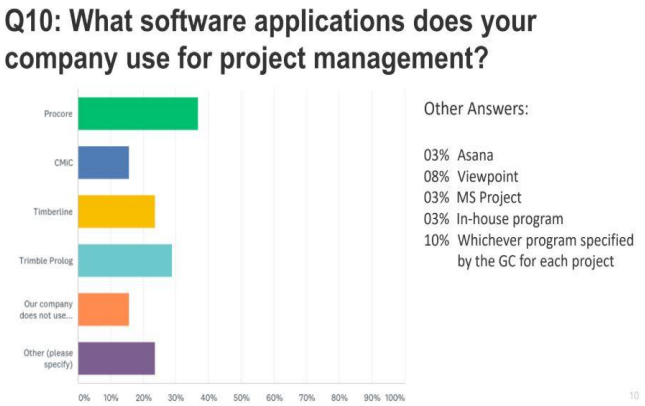


Figure 5: Industry Use of Project Management Applications

Scheduling Applications

After analyzing project management, scheduling was next on the list to gauge student comfortability. Results from the industry survey indicated that 65% of companies utilize Primavera P6 to complete their schedules while 61% utilize Microsoft Project. Student comfort with scheduling reflects that students are more comfortable using Microsoft Project than P6. The average student comfort level for scheduling with Project was 61%. The average student comfort level with P6 was an astonishing 32% (see appendix A). Since most construction companies utilize P6 for their schedules, the Construction Management Department should make it a priority to teach P6 in more labs thus allowing graduates to feel comfortable in scheduling skills using programs like Primavera. Students are exposed to P6 in CM 313, Commercial Construction, however, having students learn scheduling on P6 earlier would allow for greater success through the other course the department offers.

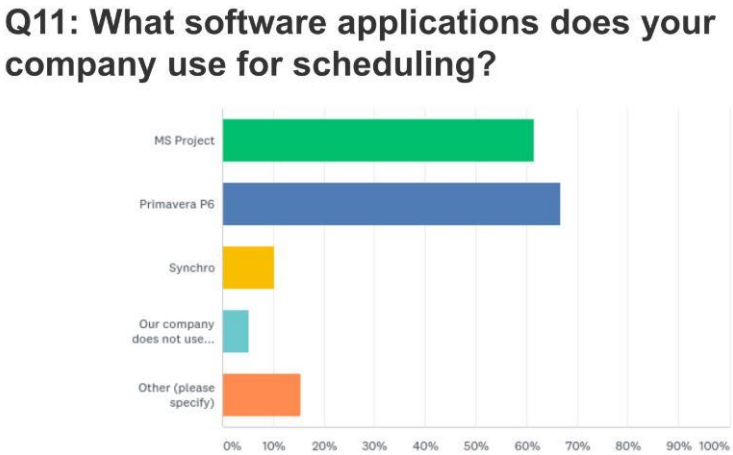


Figure 6: Industry Use of Scheduling Applications

Quantity Takeoff Applications

Quantity takeoffs are an integral part of the construction industry because it includes measuring, counting, and organizing designated materials to come up with a number of supplies needed to complete a building. Over the years the Construction Management Department has focused on different estimating software (PlanSwift, Bluebeam, Destini Profiler, etc.) for students to become familiar with taking off materials in plans. The results from the student survey show that 82% of students understand how to use Bluebeam as an estimating tool which directly correlates with industry numbers. While results from industry show that 71% of companies utilize Bluebeam for estimating, 67% use OST, otherwise known as OnScreen Takeoff. In a majority of the labs Bluebeam is used, however with OST being a strong second competitor, the CM department should implement OST into the curriculum, so graduates will be better equipped to handle estimating if they chose to go the Pre-Construction route once graduated.

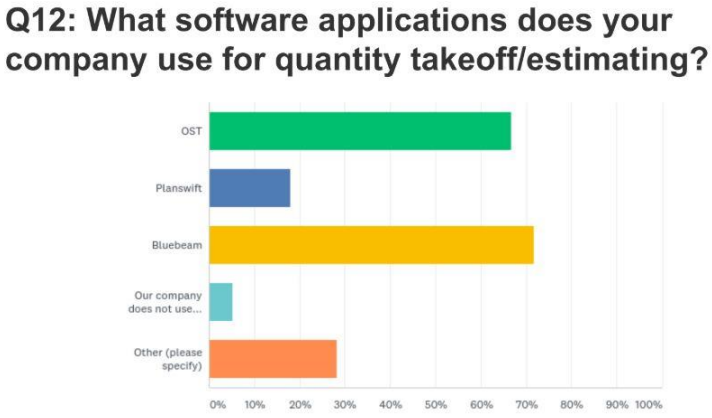


Figure 7: Industry use of Scheduling Applications

Modeling Software

Since BIM was introduced into the construction industry virtual modeling has been a top priority for most contractors. Within the Construction Management Department, BIM is used in CM 420 (Building Information Modeling), however, so many programs are taught it becomes overwhelming for students to understand the concept of each application. According to the industry survey, 72% of companies use Revit for architectural modeling, 50% of companies use AutoCAD for architectural modeling, and 67% use Revit for structural modeling. The student survey focused on comfort with Revit and AutoCAD. An average 42% was the comfort level of students using AutoCAD which shows that the department should make more of an effort to teach AutoCAD in other labs rather than only in CM 115, the Fundamentals of Construction Management. In addition, an average of 49% was the student comfort level using Revit. Revit is used in CM 115, CM 413, and CM 420 yet, with a large number of companies using Revit for modeling, the department should implement Revit into all other labs, so graduates feel comfortable using Revit as modeling software.

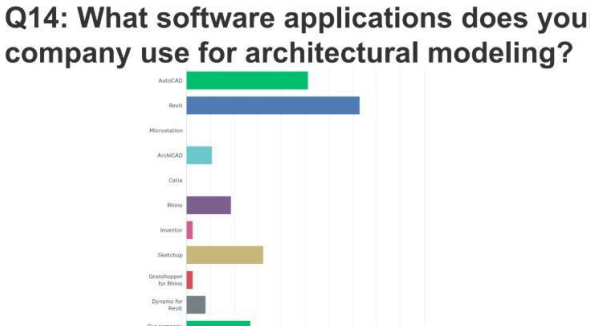


Figure 8: Industry Use of Modeling Software

Software which Graduates Should Know

According to data shown in the industry survey, there are a number of programs students should understand how to use once they graduate. The student survey focused on OnScreen Takeoff, Trimble Total Station, Navisworks, ArchiCad, and Prolog. The survey asked students to rank the programs listed above in order of importance. 50% of students answered that OnScreen Takeoff was the most important software graduates should understand how to use. 33% of students answered that Prolog was the second most important program graduates should know how to use. 34% of students answered that Navisworks was the third most important software graduates should be able to use. 30% of students answered that ArchiCad was the fourth most important software graduates should know how to use. Finally, 31% of students answered that Trimble Total Station was the least important of all programs. These numbers show the CM Department that OnScreen Takeoff should be implemented into the curriculum as well as Prolog. Implemening OnScreen Takeoff into a current lab or even creating mandatory estimating technical elective would benefit students in the long run because it would show industry members that Cal Poly graduates are well versed in multiple types of estimating software. Furthermore, it would be interesting to utilize Prolog in CM 413, Jobsite Construction, as well as utilizing the project management software that is already used, Procore. Using these two project management applications would increase student knowledge of the different tasks different project management programs can complete while allowing students gain more experience using the software.

Future Knowledge

A question asked in the industry survey which Forster found interesting was what software applications the company uses for laser scanning/processing point clouds. While 43% of companies do not utilize laser scanning, a close 35% of companies use FARO Scene. Implementing laser scanning into the curriculum would be a smart addition because it would set the Cal Poly Construction Management Department apart from other schools that offer CM as a major. Having students learn how to use laser scanners would benefit the student body as a whole because they would learn the speed, accuracy, and consistency of a scanner as well as the valuable data for design which would eliminate any guesswork when completing class projects.

Another question that was addressed in the industry survey was on surveying and layout. Students in the CM Department are required take BRAE 237 where they learn how to use a Total Station but not much emphasis is placed on surveying in any actual Construction Management course. With 58% of companies using Trimble Total Stations for surveying and layout, Forster feels as though it would be beneficial to offer a surveying and layout course as a technical elective. Offering this course in addition to having students take BRAE 237 would reinforce the ideas learned from the surveying class, thus allowing students to achieve greater success in the future.

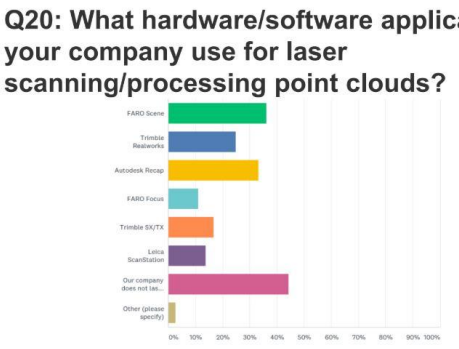


Figure 9: Industry Use of Laser Scanning

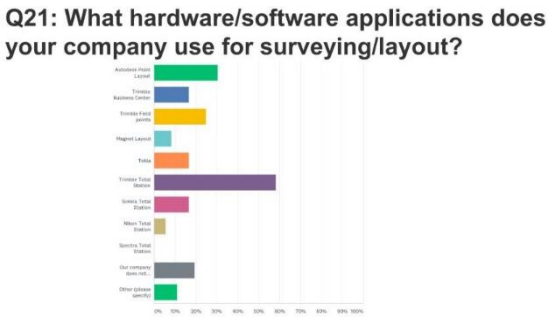


Figure 10: Industry Use of Surveying and Layout

Conclusion

During Forster's time in the Construction Management Department at Cal Poly, she has been exposed to multiple programs which have benefitted her on internships, in class, and will continue to benefit her once she graduates. However, with construction technology constantly changing it is important students are exposed to the most up-to-date industry standard technology. This research project was designed to evaluate the needs of the students in the Construction Management Department when it comes to which technologies should be taught in school. Improving the current curriculum to better align with the needs of construction companies would benefit the entire student body as well as future employers. Before beginning her research, Forster felt as though the department needed to place more emphasis and scheduling and estimating and the results of her student survey corresponded with her initial hypothesis. In regards to the other software utilized throughout the Construction Management Department, the data correlated with Forster hypothesis that the programs being taught are up to date with industry standards.

References

Becerik-Gerber, B., Gerber, D. J., & Ku, K. (2011). The pace of technological innovation in architecture, engineering, and construction education: integrating recent trends into the curricula. *Journal of Information Technology in Construction*, *16,* 411-432

Engelhardt, A & Suermann, P (2014), Evaluating Computer Technology in Construction Education: Hardware and Software. In *50th ASC Annual International Conference Proceedings*

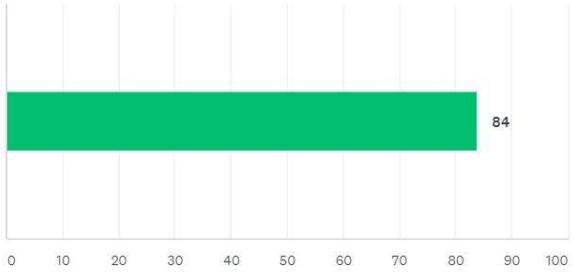
Grant, D. M., Malloy, A. D., & Murphy, M. C. (2009), A Comparison of Student Perceptions of their Computer Skills to their Actual Abilities. *Journal of Information Technology Education, 8,* 141-160

Reed, Matty (2017). Technology Utilization in AEC Industry. *Professional Survey*

Appendix A

How comfortable do you feel using Microsoft Office applications?

Answered: 54 Skipped: 0

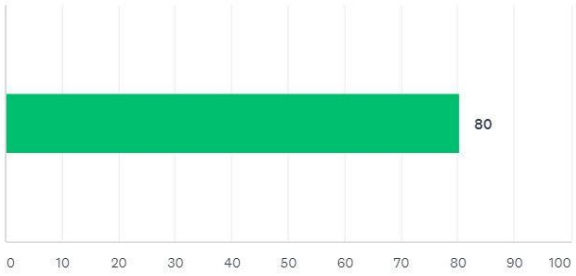


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	84	4,530	54

Total Respondents: 54

How comfortable do you feel using Bluebeam as a document control application?

Answered: 54 Skipped: 0

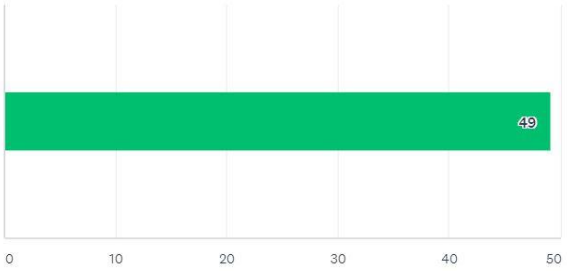


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	80	4,339	54

Total Respondents: 54

How comfortable do you feel using Procore as a project management application?

Answered: 54 Skipped: 0



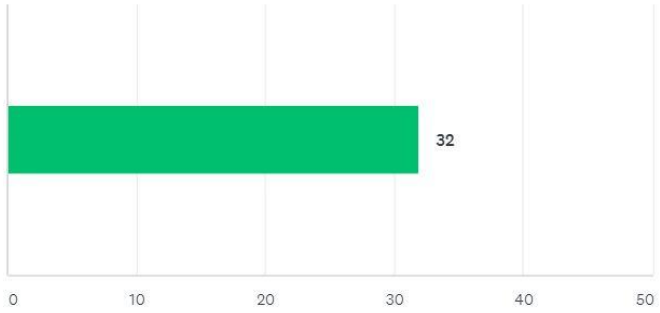
ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	49	2,655	54

Total Respondents: 54

Appendix B

How comfortable do you feel scheduling in P6?

Answered: 54 Skipped: 0

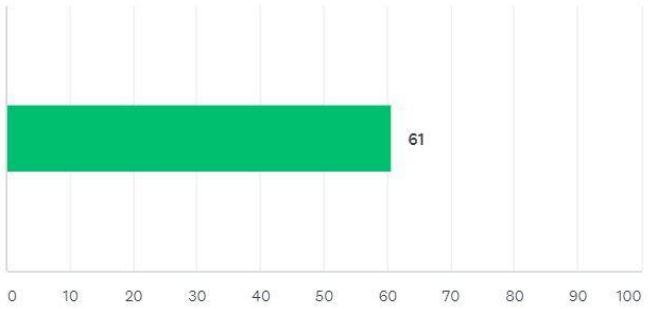


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	32	1,720	54

Total Respondents: 54

How comfortable do you feel scheduling in Microsoft Project?

Answered: 54 Skipped: 0

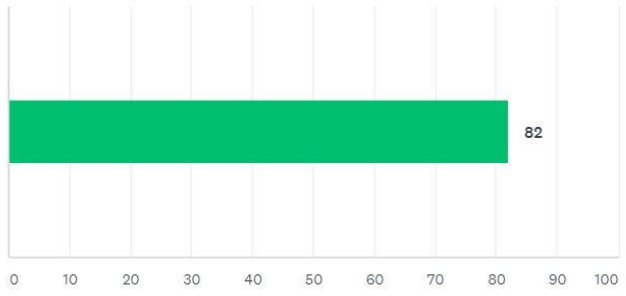


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	61	3,279	54

Total Respondents: 54

How comfortable do you feel completeing a quantity takeoff/estimate in Bluebeam?

Answered: 54 Skipped: 0



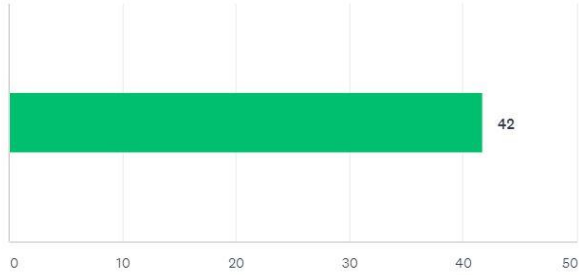
ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	82	4,424	54

Total Respondents: 54

Appendix C

How comfortable do you feel using AutoCAD for modeling?

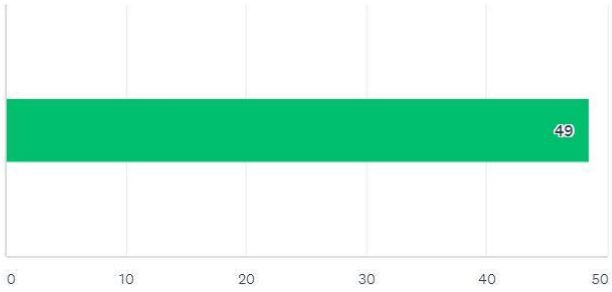
Answered: 54 Skipped: 0



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	42	2,251	54
Total Respondents: 54			

How comfortable do you feel using Revit for modeling?

Answered: 54 Skipped: 0



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	49	2,619	54
Total Respondents: 54			

Q10 As informed by industry, there are a number of software's you should know how to use once you graduate. Rank from most important to least important. (1 = most, 5 = least)